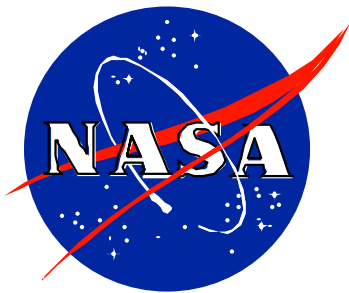


Phase II Flight Safety Data Package for the Human Research Facility

July 1997
(Original release)



**National Aeronautics and
Space Administration**

**Lyndon B Johnson Space Center
Houston, Texas 77058**

LS-71027-3

PREFACE

This addition to the Human Research Facility (HRF) Phase II Flight Safety Data Package represents Chapter 37 of LS-71027-3. This Chapter covers the HRF Muscle Atrophy Research and Exercise System (MARES) Rack. This rack will be used to facilitate the launch, stowage, deployment and operation of the HRF MARES hardware. MARES is covered in Chapter 24 of this document. The MARES and MARES rack are currently scheduled to launch within the MPLM on the UF3 ISS flight. The design is being presented to the Payload Safety Review Panel at a Critical Design Review level.

Most verifications related to this hardware item remain open.

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Appendix 37A: Hazard Reports for the HRF MARES Rack

Appendix 37B: FDS Reporting Form

37.0 HUMAN RESEARCH FACILITY (HRF) MUSCLE ATROPHY RESEARCH AND EXERCISE SYSTEM (MARES) RACK

The HRF MARES Rack is a payload integration development to facilitate the launch, stowage, deployment, and operation of the MARES, which is provided by the European Space Agency (ESA). The MARES device will be used on-orbit to conduct research on musculoskeletal, biomechanical, neuromuscular and neurological physiology by assessing the strength of isolated muscle groups. The rack will be an International Standard Payload Rack (ISPR) outfitted with power and structural capabilities for use with MARES only.

37.1 HARDWARE DESIGN

The purpose of the HRF MARES Rack is to accommodate the stowage and deployment of the HRF Muscle Atrophy Research and Exercise System (MARES) and to provide a power interface to the Standard Utility Panel (SUP), Utility Outlet Panel (UOP), or Utility Interface Panel (UIP). The HRF MARES Rack will launch in the MPLM on UF-3 and be installed in a rack space within the Attached Pressurized Module (APM). All HRF MARES Rack components, except the rack structure and MARES Main Box, will be soft stowed during launch.

Following transfer of this hardware to the APM, the MARES hardware will be attached to the Vibration Isolation Frame (VIF). The VIF is launched within the MARES rack and attaches to the front of the MARES Rack structure via seat tracks for on-orbit operations. The purpose of the Vibration Isolation Frame is to avoid perturbation of the microgravity environment of ISS while MARES is in use. At the same time, it keeps MARES in its correct position, and limits the range of displacement of the equipment. Requirements for the VIF are included in the MARES design and are not part of this safety analysis. MARES power is obtained primarily through the rack UIP connector or secondarily via a SUP/UOP.

During on-orbit operations, MARES will be deployed in the aisle. When not in use on-orbit, MARES will be stowed.

The following hardware is included in this safety assessment as part of the HRF MARES rack.

Item Name	Part Number	Notes
HRF MARES Rack Structure	SEG46119580	mounted to MPLM for launch, APM on-orbit
PIP (Power Interface Panel)	SEG46119490	portable, mounted on seat tracks
UIP-PIP Power Cable	SEG46119589	main J1 power, primary
SUP/UOP-PIP Power Cable	SEG46119590	SUP or UOP to PIP connection, secondary
PIP-MARES Power Cable	SEG46115684	PIP to MARES cable
UIP-PIP Data Cable	SEG46119591	RMS interface
HRF MARES Rack Stowage Kit(s)		Exact stowage configurations within kits is TBD

37.1.1 HRF MARES Rack Structure

The HRF MARES Rack structure will be located in the Columbus APM provided by ESA. The structure design is based on an International Standard Payload Rack (ISPR). The following structural modifications were made to the standard International Standard Payload Rack (ISPR):

- The upper intercostal was removed and replaced with a recessed shelf
- The two center posts were removed.
- Both halves of the Structural Utility Panel were removed.
- Post reinforcement clips were installed
- Pressure Relief Assemblies and doubler plates were replaced with blank plugs.

The following items were added to the modified ISPR:

- Internal side frame (X-frame)
- Launch Stowage Plate (LSP) Support Structure
- Stowage drawer (in place of the Structural Utility Panel)
- Unique Utility Panel added ?

The MARES Rack structure allows for deployment and stowage of the MARES system within an empty rack space. Figures 37.2.1-1, 37.2.2-1 and 37.2.2-2 show the different configurations of the MARES rack.

The HRF MARES Rack structure is designed to accommodate all MARES hardware manifested for UF-3 during launch.

37.1.2 Power Interface Panel (PIP)

The Power Interface Panel (PIP) is a portable power interface between the MARES and either the UIP or the SUP/UOP. The box may be relocated, if necessary, in support of the MARES. The maximum capacity of the PIP will be 120VDC at 10A. At worst-case cabin temperature, the outer surface of the PIP could reach touch temperature after 2-3 hours if the current draw was greater than 6.9 amps. The MARES hardware requires a maximum of 5 amps. A thermal cutoff switch set to 54°C is incorporated in the design in case the PIP was used for another application in the future. This cutoff temperature equates to an outer surface temperature of 47.1°C. The interface concept for the UIP/SUP/UOP, PIP, and MARES is shown in Figure 37.1.2-1. An electrical schematic of the PIP is given in Figure 37.1.2-2 and a drawing is shown in figure 37.1.2-3.

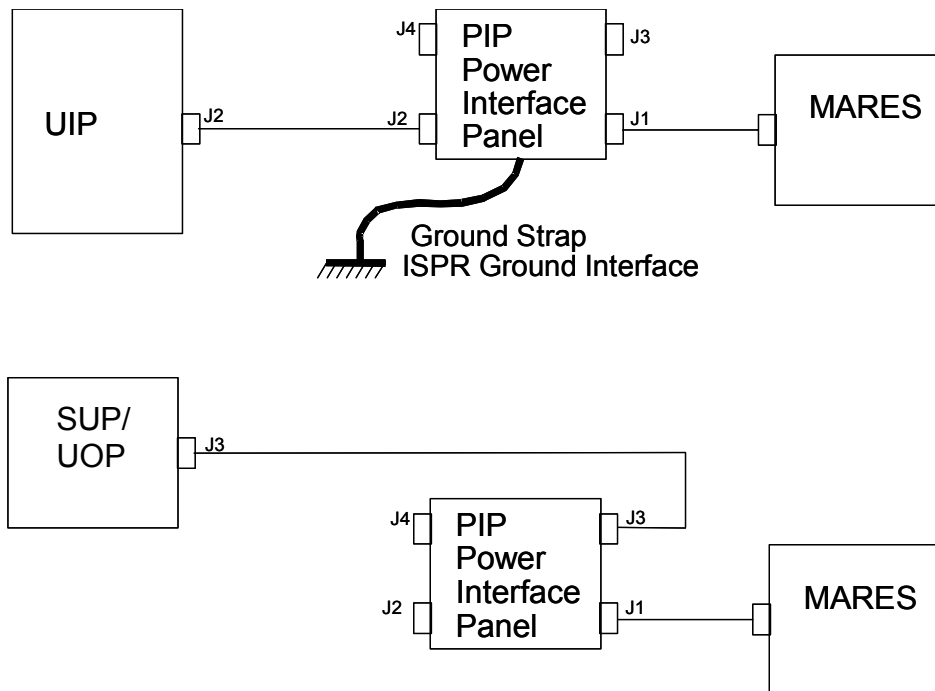


Figure 37.1.2-1 Power Interface Panel Connections

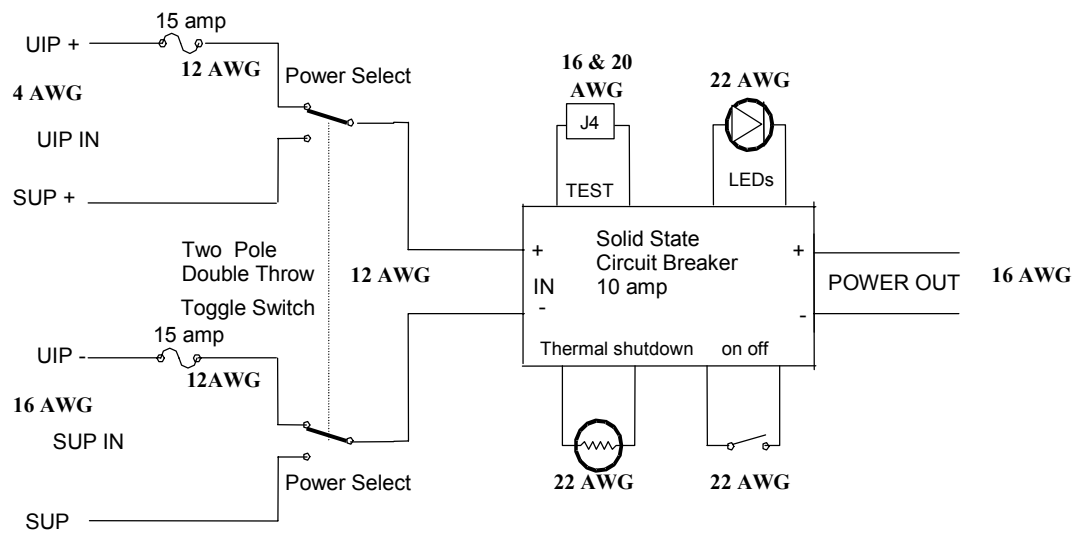


Figure 37.1.2-2 Power Interface Panel Schematic

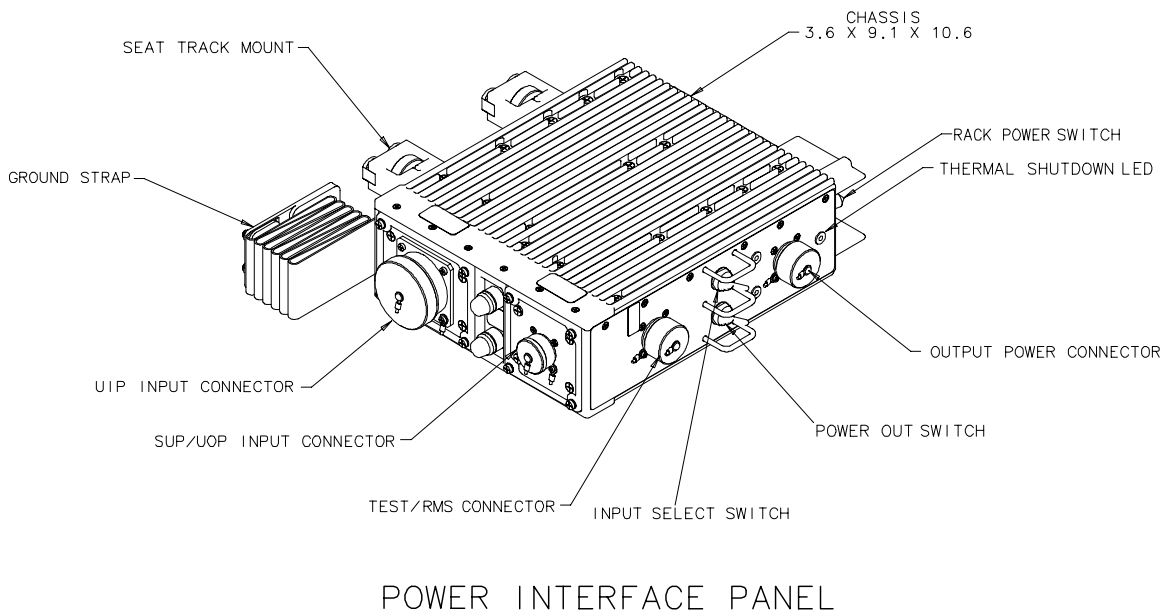


Figure 37.1.2-13 Power Interface Panel

37.1.3 UIP-PIP Power Cable

The UIP-PIP Power Cable is the electrical power cable that connects the APM's electrical power source on the UIP to the Payload Interface Panel (PIP). This will be the nominal power source for the MARES.

37.1.4 SUP/UOP-PIP Power Cable

The SUP/UOP-PIP Power Cable connects the APM electrical power source on the SUP, or the Lab Module UOP, to the PIP. The SUP/UOP will be used as an alternative power source.

37.1.5 PIP-MARES Power Cable

The PIP-MARES Power Cable connects the PIP to the MARES Main Box.

37.1.6 PIP-UIP Data Cable

The PIP-UIP Data Cable connects the PIP to the UIP. This interface allows the Rack Maintenance Switch (RMS) within the PIP to activate/deactivate the UIP power interface.

37.2 OPERATIONS

37.2.1 Launch/Ascent and Transport to Station

The HRF MARES Rack structure will be launched in the MPLM on UF3. The MARES Rack structure will be installed into the APM on-orbit. All components will be stowed during launch and are neither powered nor operated.

All MARES hardware that is utilized for on-orbit checkout will be flown on UF-3. The HRF MARES Rack will accommodate this hardware during launch; either mounted to the HRF MARES Rack structure or stowed in containers. See the current concept in figure 37.2.1-1.

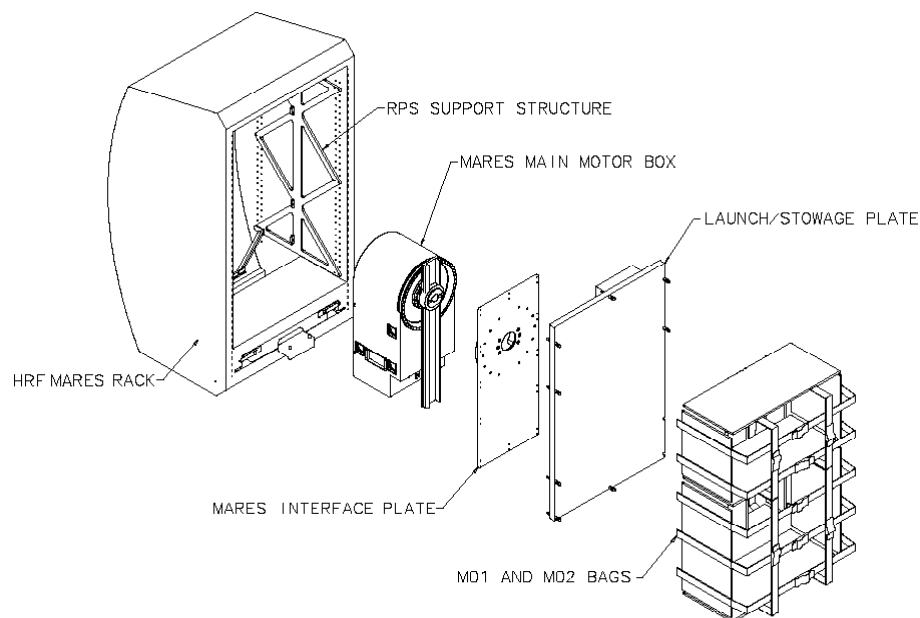


Figure 37.2.1-1 HRF MARES Rack Launch Concept - Exploded

37.2.2 On Orbit Scenario

The HRF MARES Rack and MARES hardware will be transferred to the APM following docking with ISS. The VIF will be attached to the MARES Rack for on-orbit stowage and attached via standard seat tracks to the front of the rack during on-orbit usage. The MARES Main Box, Pantograph, and Chair are attached to the VIF for on-orbit use, and detached for stowage. Hardware accessories will be placed in the free space around the Main Box, Pantograph, Chair and VIF for on-orbit stowage. All MARES accessories will be deployed only when needed for operations. See figures 37.2.2-1 and 37.2.2-2.

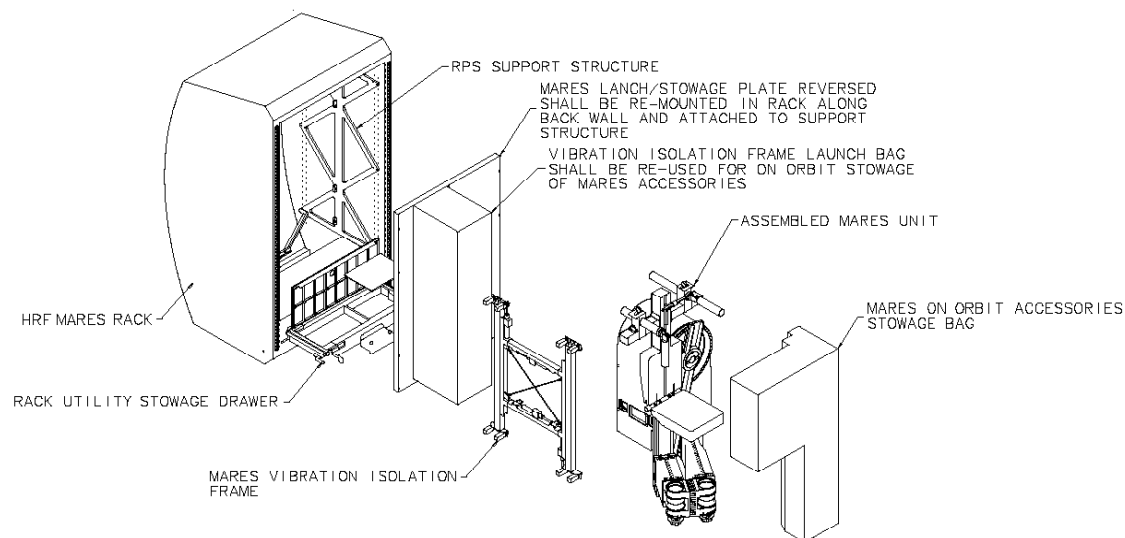


Figure 37.2.2-1 HRF MARES Rack On-orbit Stowage Concept - Exploded

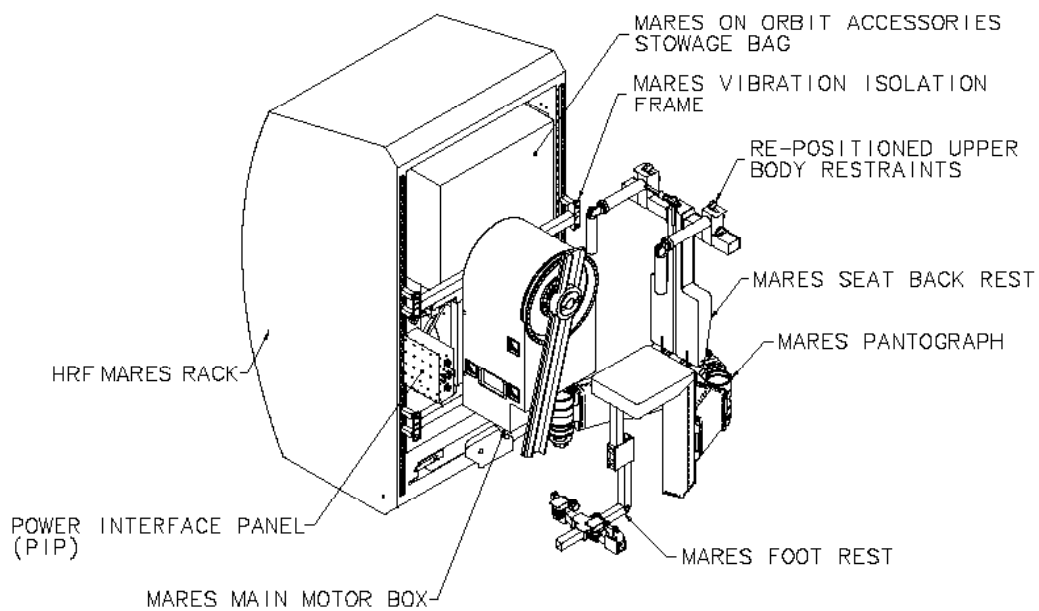


Figure 37.2.2-2 HRF MARES Rack On-orbit Deployment Concept

37.2.3 Rapid Safing

While MARES is in its stowed configuration, there are no special procedures required in the event of an emergency egress. During operations, there is at least one configuration of MARES that could interfere with emergency egress. In the event of a rapid safing situation while in this configuration, MARES could be reconfigured to accommodate an egress path in less than 30 seconds. The issues associated with this are covered in the MARES safety data package.

37.2.4 Fire Protection

Fire prevention is handled in the design process. The HRF MARES rack components are made with approved materials and with proper wire sizing and circuit protection. Elimination of fire sources through conformal coating and

electronic parts derating has been implemented in the design. Proper grounding is also implemented.

Fire detection for the Power Interface Panel will be handled by the area smoke detector.

The Power Interface Panel design does not include a cooling fan or a Portable Fire Extinguisher (PFE) port. The PIP consists of less than 30% free volume within a 60 mil thick container. This meets the definition of a sealed container per NSTS 22648 and is, therefore, considered to be self-extinguishing.

37.2.5 Maintenance and calibration

No maintenance or calibration is required during the on-orbit life of the HRF MARES rack components. Should the PIP fail while on-orbit, it will be replaced.

37.3 MARES RACK INTERFACE REQUIREMENTS

No critical services are required from the orbiter or ISS for this hardware item.

The interfaces between the HRF MARES Rack components, MARES, and ISS are presented in Figure 37.3-1.

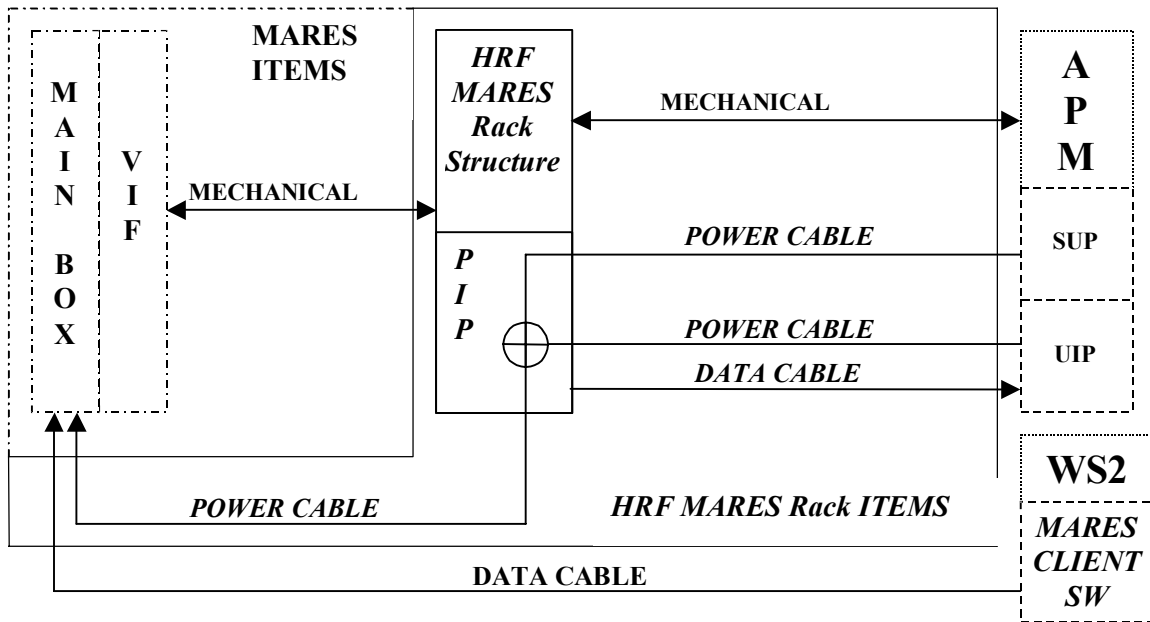


Figure 37.3-1 HRF MARES Rack Interfaces

37.3.1 Structural/Mechanical Interfaces

Vibration Isolation Frame (VIF) to HRF MARES Rack: The Vibration Isolation Frame attaches to the HRF MARES Rack via seat tracks.

HRF MARES Rack to APM: The HRF MARES Rack structure attaches to the APM at existing rack attachment points.

HRF MARES Rack to MPLM: The HRF MARES Rack structure attaches to the MPLM at existing rack attachment points.

HRF MARES Rack to MARES Main Box: For launch, the MARES Main Box attaches to the MARES Rack structure via a launch plate mounted within the Rack structure (see figure 37.2.1-1). During on-orbit stowage, the Main Box attaches to the launch plate by utilizing the same attachment points (on MARES) used during on-orbit operations (see figure 37.2.2-1). During on-orbit operations, the Main box is attached to the Vibration Isolation Frame (part of

MARES hardware), which is then attached to the seat tracks of the MARES rack (see figure 37.2.2-2).

37.3.2 Electrical Interfaces

UIP Power Interface:

Electrical power will nominally be supplied through the UIP connector on the Z-panel of the APM rack space. The UIP-PIP Power Cable is the interface that attaches the UIP to the PIP. The PIP-MARES Power Cable is used to connect the MARES to the PIP and provide the MARES Main Box its 120VDC electrical power.

SUP/UOP Power Interface:

Electrical power can also be supplied through the SUP connectors in the APM or the UOP connectors in the US Lab. The SUP/UOP-PIP Power Cable is the interface between the SUP/UOP and the PIP in this configuration. The PIP-MARES Power Cable is used to connect the MARES to the PIP and provide the MARES Main Box its 120VDC electrical power.

The power cables provide a dual ground path for the high voltage sources. When attached to the UIP interface, the PIP uses a grounding strap attached to the ISPR ground interface. This is necessary because the UIP interface does not provide a ground pin nor a grounded backshell.

37.3.3 Data

PIP to UIP: The PIP interfaces to the J43 data connector on the UIP. This interface allows the Rack Maintenance Switch (RMS) to be used to activate the UIP power interface to the PIP. This interface is made with the PIP-UIP Data Cable.

MARES Workstation Client Software to MARES: The HRF MARES Rack includes a client software application on the HRF Workstation 2 (WS2) that allows for real-time downlink of MARES data. This interface is made with the HRF Common Ethernet Cable.

37.4 MARES RACK SAFETY ASSESSMENT

Payload safety critical subsystems are normally subdivided into pressure systems, radiation, mechanical, structural, electrical, human factors, and materials categories for consideration. The following categories are applicable to the HRF MARES rack and are documented on the Form 1230 in Appendix 37A. Unique hazard reports have been generated for high voltage and structural failure and can be found in Appendix 37B. The only items requiring crew procedures or crew training as a hazard control are ensuring upstream power is off prior to mate/demate operations and ensuring the bonding strap is installed in the UIP configuration.

37.4.1 Human Factors

Construction of the HRF MARES rack will meet the requirements specified in SSP 57000, section 3.12.9.2, for sharp edges, corners, or protrusions. No potential pinch points have been identified.

The Power Interface Panel will meet touch temperature requirements of letter MA2-95-048, "Thermal Limits for Intravehicular Activity (IVA) Touch Temperature". At worst-case cabin temperature, the outer surface of the PIP could reach touch temperature after 2-3 hours if the current draw was greater than 6.9 amps. The intended operations for the PIP is in conjunction with the MARES hardware which requires a maximum of 5 amps. A thermal cutoff switch set to 54°C is incorporated in the design in case the PIP was used for another application in the future. This cutoff temperature equates to an outer

surface temperature of 47.1°C. The unit will not automatically restart. An LED will illuminate to signal an over temperature condition.

37.4.2 Materials

All materials selected for the manufacture and construction of flight hardware and equipment, both metallic and non-metallic, meet the requirements specified in applicable requirements documentation (MSFC-HDBK-527/JSC 09604, “Materials Selection List for Space Hardware Systems”; SSP 30233, “Space Station Requirements for Materials and Processes”; NSTS 1700.7B, “Safety Policy and Requirements for Payloads Using the Space Transportation System”; and NSTS 1700.7 ISS Addendum, “Safety Policy and Requirements for Payloads Using the International Space Station”). JSC/ES4 will review and approve all materials for the HRF MARES rack and supply the material certification prior to flight.

No toxic materials are used in conjunction with this hardware item. There are no shatterable materials associated with the HRF MARES rack. All LEDs used are plastic.

37.4.3 Electrical

Circuit protection devices and wire sizes will be selected in accordance with TM102179, “ Selection of Wires and Circuit Protection Devices for NSTS Orbiter Vehicle Payload Electrical Circuits” as interpreted by TA-92-038.

All electrical connections will be made per procedures with the power to the upstream source turned off.

The Power Interface Panel will be in compliance with SSP 30237, “Space Station Electromagnetic Emission and Susceptibility Requirements”. EMI compatibility testing will be performed.

37.4.4 Batteries

There are no batteries associated with this hardware.

37.4.5 Rapid Safing

The HRF MARES rack will meet the rapid safing requirements of Letter MA2-96-190 and will not impede emergency IVA egress into other pressurized volumes.

37.4.6 Structures

The HRF MARES rack will meet the safety critical structure design requirements of NSTS 14046 and SSP 52005 for mission induced loads during all phases of flight. Structural analysis will verify that positive margins of safety have been achieved. The JSC/ES4 materials branch will verify that materials have been selected in accordance with MSFC-STD-3092 and approve any MUA's. Structural fasteners will be in conformance with JSC23642 and will be properly secured using locking inserts or nutplates.

The ISPR is provided by OZ/ISS Payloads Office and modified by EB/Human Life Sciences Engineering Division. Structural analysis of the MARES rack will be a joint effort between Boeing and Lockheed Martin. Analysis of the MARES experiment hardware during launch and on-orbit operations will be the responsibility of NTE/ESA and will be covered in the MARES safety data package and the MARES structural failure hazard report. The details are outlined below:

Structural analysis of the modified ISPR will be performed by Boeing. The modifications to the ISPR were listed in section 37.1.1. This analysis includes forces applied to the rack structure during launch/landing and on-orbit operations.

This analysis includes data concerning the launch/landing configuration with MARES hardware installed.

Launch/landing loads for the MARES integration hardware will be analyzed by Lockheed Martin. This hardware includes the internal side frame, stowage plate, and stowage drawer that were added to the modified ISPR.

The MARES, including all peripheral hardware for the MARES experiment, and the VIF will be analyzed by NTE/ESA according to the MARES Structural Verification Plan, MARES-0000-PL-177-NTE. This assessment will include analyzing the main box for launch/landing loads and considering on-orbit loads and the force that will be induced at the seat track. The forces seen at the seat track during on-orbit operations will feed into the Boeing's analysis of the ISPR.

37.4.7 Safety Re-verifications

No periodic re-verifications are required to ensure safe operation for the life of this hardware item.

37.4.8 Action Items/Non-compliances/Hardware Anomalies

No action items have been assigned to this hardware item. The electrical schematics were updated following the Phase I safety review in response to an agreement. No non-compliances have been identified with this hardware. No safety-related anomalies have occurred with this hardware item.

Appendix 37A

Hazard Reports for the HRF MARES Rack

FLIGHT PAYLOAD STANDARDIZED HAZARD CONTROL REPORT		A. NUMBER	B. PHASE	C. DATE
		STD- MARES rack	Phase II	October 2003
D. PAYLOAD, DTO, DSO or RME (Include Part Number(s), if applicable)		HAZARD TITLE		E. VEHICLE
Human Research Facility - HRF MARES Rack		STANDARD HAZARDS		Shuttle/Station
F. DESCRIPTION OF HAZARD:	G. HAZARD CONTROLS: (complies with)	H. APP.	I. VERIFICATION METHOD, REFERENCE AND STATUS:	
1. Structural Failure (payloads must comply with the listed requirements for all phases of flight) <i>Note: Locker and Soft Stowage items only.</i>	a) Designed to meet the standard modular locker stowage requirements of NSTS 21000-IDD-MDK or equivalent IDD _____, or b) Stowed in SPACEHAB per MDC91W5023.	<input type="checkbox"/> <input type="checkbox"/>	See unique hazard report MRack-1	
2. Structural Failure of Sealed Containers	Sealed containers must meet the criteria of NASA-STD-5003, Para. 4.2.2.4.2.3a, contain a substance which is not a catastrophic hazard if released, be made of conventional metals, and have a maximum delta pressure of 1.5 atm.	<input type="checkbox"/>	N/A	
3. Structural Failure of Vented Containers	For intentionally vented containers, vents are sized to maintain a 1.4 factor of safety for Shuttle or a 1.5 factor of safety for Station with respect to pressure loads. Meets all of the applicable pressure rates defined for one or more of the following. i. Shuttle payload bay – ICD 2-19001, Para. 10.6.1 ii. Station environment – SSP 52005, paragraph 4.1.12 or equivalent payload specific ICD _____ iii. Station PFE discharge – SSP 57000, Para. 3.1.1.4K, or equivalent payload specific ICD _____	<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	Analysis will be provided to show the Power Interface Panel will maintain a positive margin of safety during depress/repress. OPEN, expected closure 3/04.	
4. Sharp Edges, Corners, and/or Protrusions.	Meets the <u>intent</u> of one or more of the following: a) NASA-STD-3000 / SSP 50005 b) SLP 2104 c) NSTS 07700 Vol. XIV App. 7 (EVA hardware) d) NSTS 07700 Vol. XIV App. 9 (IVA hardware) / SSP 57000	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/>	Sharp edge inspection of as-built flight hardware. OPEN, expected closure 4/04.	

FLIGHT PAYLOAD STANDARDIZED HAZARD CONTROL REPORT		A. NUMBER		B. PHASE		C. DATE	
		STD- MARES rack		Phase II		October 2003	
D. PAYLOAD, DTO, DSO or RME (Include Part Number(s), if applicable)		HAZARD TITLE			E. VEHICLE		
Human Research Facility - HRF MARES Rack		STANDARD HAZARDS			Shuttle/Station		
F. DESCRIPTION OF HAZARD:	G. HAZARD CONTROLS: (complies with)	H. APP.	I. VERIFICATION METHOD, REFERENCE AND STATUS:				
5. Shatterable Material Release	a) All materials are contained. b) Optical glass (i.e. lenses, filters, etc.) components of crew cabin experiment hardware that are non-stressed (no delta pressure) and have passed both a vibration test at flight levels and a post-test visual inspection. c) Payload bay hardware shatterable material components that weigh less than 0.25 lb and are non-stressed (no delta pressure) or non-structural.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	N/A				
6. Flammable Materials	a) A-rated materials selected from MAPTIS, or b) Flammability assessment per NSTS 22648	<input checked="" type="checkbox"/> <input type="checkbox"/>	Review/approval of material list by JSC ES4. OPEN, expected closure 3/04.				
7. Materials Offgassing	a) Offgassing tests of assembled article per NHB 8060.1 and/or NASA-STD-6001	<input checked="" type="checkbox"/>	Review/approval of offgas testing by JSC ES4. OPEN, expected closure 3/04.				
8. Nonionizing Radiation	a) Pass ICD-2-19001, 10.7.3.2.2 / SSP 30238 EMI compatibility testing, or	<input checked="" type="checkbox"/>	Review of test results for successful completion of EMI compatibility testing of Power Interface Panel. OPEN, expected closure 3/04.				
8.1 Non-transmitters	b) NSTS/USA approved analysis ICD Section 20, or	<input type="checkbox"/>					
	c) ISS/EMEP approved TIA	<input type="checkbox"/>					
8.2 Lasers	a) Beams are totally contained at the maximum possible power and there is no crew access, or b) Meet ANSI Z136.1-1993 for class 1, 2, or 3a Lasers (as measured at the source).	<input type="checkbox"/> <input type="checkbox"/>	N/A				

FLIGHT PAYLOAD STANDARDIZED HAZARD CONTROL REPORT		A. NUMBER	B. PHASE	C. DATE
		STD- MARES rack	Phase II	October 2003
D. PAYLOAD, DTO, DSO or RME (Include Part Number(s), if applicable)		HAZARD TITLE		E. VEHICLE
Human Research Facility - HRF MARES Rack		STANDARD HAZARDS		Shuttle/Station
F. DESCRIPTION OF HAZARD:	G. HAZARD CONTROLS: <i>(complies with)</i>	H. APP.	I. VERIFICATION METHOD, REFERENCE AND STATUS:	
14. Mating/demating powered connectors	a) Meets the low power criteria of letter MA2-99-170 or, b) Meets the paragraph 1 criteria of letter MA2-99-170 (e.g., IVA and open circuit voltage no greater than 32 volts).	<input type="checkbox"/> <input type="checkbox"/>	See unique hazard report Mrack-2.	
15. Contingency Return and Rapid Safing	Shuttle Environment: a) If middeck payload – can be stowed within 50 min. (see paragraph 3 of letter MA2-96-190). b) If transfer item – can establish a safe for return configuration within 3 min. (see paragraph 5 of letter MA2-96-190). Station Environment: c) Payload design does not impede emergency IVA egress to the remaining adjacent pressurized volumes.	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/>	Payload consists of hardware within a rack space and will not impede emergency IVA egress. CLOSED	
16. Release of Mercury from bulbs into crew habitable environment.	a) Mercury vapor bulbs contain less than 30 mg of Mercury per bulb, and b) No more than one bulb could break due to a single failure.	<input type="checkbox"/>	N/A	
APPROVAL	PAYLOAD ORGANIZATION		SSP/ISS	
PHASE I				
PHASE II				
PHASE III				

<u>Item Name</u>	<u>Part Number</u>
HRF MARES Rack Structure	SEG46119580
PIP (Power Interface Panel)	SEG46119490
UIP-PIP Power Cable	SEG46119589
SUP/UOP-PIP Power Cable	SEG46119590
PIP-MARES Power Cable	SEG46115684
UIP-PIP Data Cable	SEG46119591
HRF MARES Rack Stowage Kit(s)	

PAYLOAD HAZARD REPORT		NO: Mrack -1
PAYLOAD: HRF MARES Rack		PHASE: II
SUBSYSTEM: Structures/Mechanisms	HAZARD GROUP: Collision	DATE: October 2003
HAZARD TITLE: Structural Failure		
APPLICABLE SAFETY REQUIREMENTS: NSTS 1700.7B, paragraph 208.1, 208.2, 208.3 ISS Addendum to NSTS 1700.7B, 208.1, 208.2. 208.3 NSTS 18798, letter MA2-96-174		<input checked="" type="checkbox"/> CATASTROPHIC <input type="checkbox"/> CRITICAL
DESCRIPTION OF HAZARD: Structural failure of payload structural elements or attachment hardware results in unrestrained objects in the Orbiter or Space Station module which could impact and injure the crew or impact the orbiter, Space Station, or other payloads. Note: There are no current plans for the return of this rack. Return would require an updated safety assessment.		
HAZARD CAUSES: 1. Structural elements of payload equipment lack structural strength to withstand launch, landing, and emergency landing loads; and on-orbit operational loads and environments. 2. The use of structural materials that are susceptible to stress corrosion cracking. *See continuation sheet		
HAZARD CONTROLS: 1.1 Safety-critical structure design will be based on worst-case mission induced loads with no negative margins of safety. All designs and tests will be in accordance with NSTS 14046 and SSP 52005. Factors of safety used for structural analysis include 1.25 for yield and 2.0 for ultimate for untested structural components and 1.0 and 1.4, respectively, for ISPR tested structural components. The factors of safety used for fasteners are 2.0 ultimate, 1.25 yield. 1.2 The weight and cg of the rack payloads will be controlled to meet rack load limits. 2.1 Materials selected are in accordance with MSFC-STD-3029, table 1. *See continuation sheet.		
SAFETY VERIFICATION METHODS: 1.1.1 Structural analysis to verify positive margins of safety. 1.1.2 Frequency identification to be performed per SSP52005. 1.2.1 Structural analysis to verify weight and cg of rack payloads are within limits. 2.1.1 The JSC materials branch, ES4, will review and approve materials. *See continuation Sheet		
STATUS OF VERIFICATION: 1.1.1 OPEN 1.1.2 OPEN 1.2.1 OPEN 2.1.1 OPEN		
APPROVAL	PAYLOAD ORGANIZATION	STS
PHASE I		
PHASE II		
PHASE III		

PAYLOAD HAZARD REPORT CONTINUATION SHEET	NO: Mrack-1
PAYLOAD: HRF MARES Rack	PHASE: II

HAZARD CAUSES (continued):

3. Failure resulting from defective materials, fabrication, pre-existing flaws, or the use of counterfeit fasteners.
4. Backoff of safety-critical fasteners causing a release of mass.

HAZARD CONTROLS (continued):

- 3.1 Safety-critical structures are built in accordance with approved design drawings and parts lists.
- 3.2 Fracture Control is implemented per the Fracture Control Plan for HRF, LS-71010, in accordance with SSP 52005.
- 3.3 All structural fasteners will be in conformance with JSC 23642.
- 4.1 Design includes locking inserts or locking nutplates to preclude the backoff of safety-critical fasteners.

SAFETY VERIFICATION METHODS (continued):

- 3.1.1 QA certification that structures are built per approved drawings and parts lists.
- 3.2.1 JSC/ES4 review and approval of Fracture Control Summary Report.
- 3.3.1 Review of design to verify compliance to JSC 23642.
- 4.1.1 Review of design to show locking inserts or nutplates are used.
- 4.1.2 QA certification that fasteners are attached per approved drawings and parts lists

STATUS OF VERIFICATION:

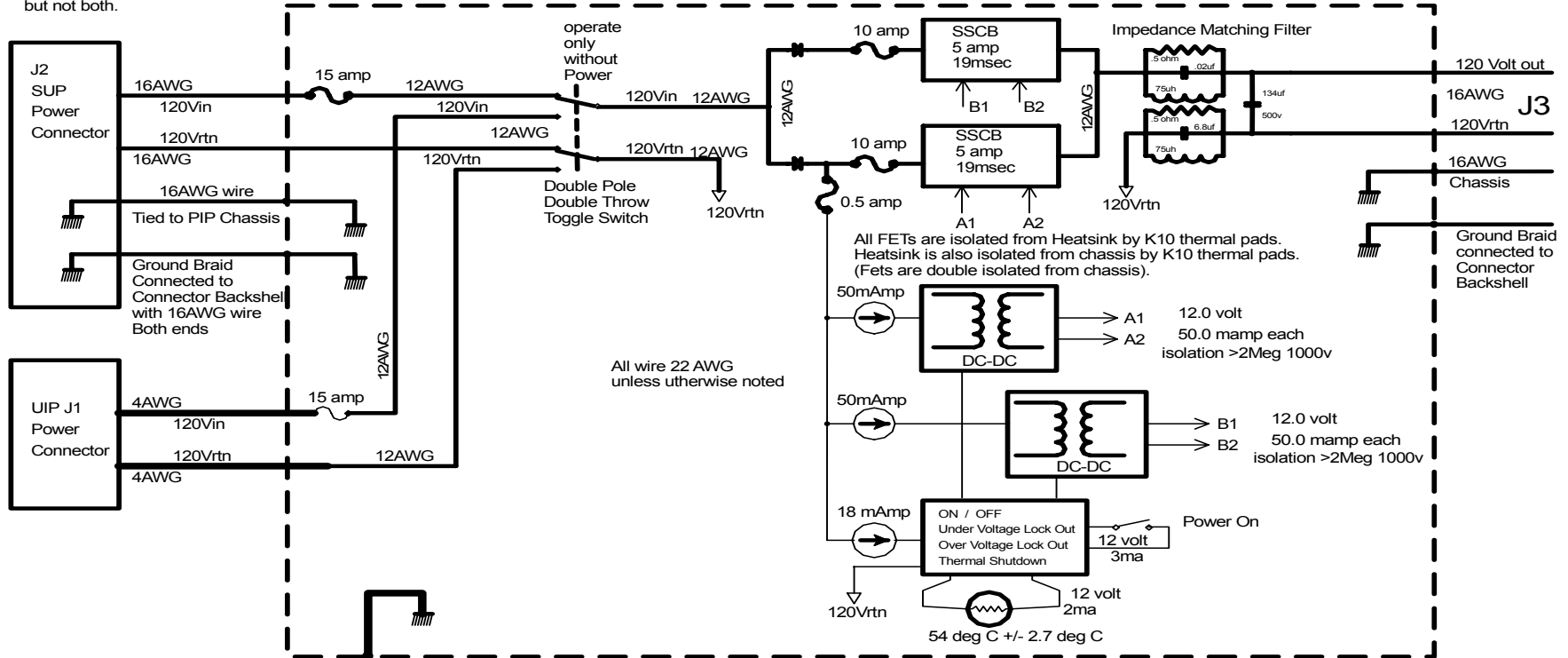
- 3.1.1 OPEN
- 3.2.1 OPEN
- 3.3.1 OPEN
- 4.1.1 OPEN
- 4.1.2 OPEN

PAYLOAD HAZARD REPORT		NO: Mrack-2
PAYLOAD: HRF MARES Rack		PHASE: II
SUBSYSTEM: Electrical	HAZARD GROUP: Injury/Illness	DATE: October 2003
HAZARD TITLE: Electrical Shock		
APPLICABLE SAFETY REQUIREMENTS: NSTS 1700.7B, paragraph 200.1b, 213 ISS Addendum to 1700.7B, paragraph 200.1b, 213 NSTS/ISS 18798B: MA2-99-142, MA2-99-170		<input checked="" type="checkbox"/> CATASTROPHIC <input type="checkbox"/> CRITICAL
DESCRIPTION OF HAZARD: Incidental contact by the crew with high voltages can lead to severe burns, possible other physiological effects and/or loss of crew. Electrical shock to the flight crew could result from contact with high voltages of 120 Vdc		
HAZARD CAUSES: 1. Defective component, wire, insulation, design and/or workmanship coupled with inadequate bonding/grounding results in shock potential. 2. Incidental contact by the crew with exposed terminals, connectors, energized conductive surfaces.		
HAZARD CONTROLS: 1.1 Hardware will be built per approved drawings to preclude the use of damaged components. 1.2 Bonding/grounding accomplished in accordance with SSP30245 (bonding requirements), SSP30240 (grounding requirements) and NSTS/ISS 18798B, MA2-99-142. Dual grounding paths are provided for SUP/UOP configuration. 1.3 Crew procedure will ensure ground strap is attached in UIP configuration. 2.1 All electronics are enclosed and inaccessible to the crew by design. 2.2 Proper procedures will ensure 120 VDC connection is not powered during mate/demate. The PIP power and rack power will be switched off.		
SAFETY VERIFICATION METHODS: 1.1.1 QA inspection/certification of as-built hardware to approved drawings and parts lists. 1.2.1 Test of bonding/grounding per SSP30245 & SSP30240, class H for electrically energized equipment. 1.3.1 Review of crew procedures. 2.1.1 Review of design to show electronics are enclosed. 2.1.2 QA inspection/certification of as-built hardware to approved drawings and parts lists. 2.2.1 Review of crew procedures for power off prior to mate/demate.		
STATUS OF VERIFICATION: 1.1.1 OPEN, expected closure 4/04. 1.2.1 OPEN, expected closure 4/04. 1.3.1 OPEN, expected closure 12/04. 2.1.1 OPEN, expected closure 2/04. 2.1.2 OPEN, expected closure 4/04. 2.2.1 OPEN, expected closure 12/04.		
APPROVAL	PAYLOAD ORGANIZATION	STS
PHASE I		
PHASE II		
PHASE III		

Power Interface Panel Grounding And Isolation Diagram

Only one power source may be connected.
Either UIP or SUP
but not both.

Power Interface Panel Chassis



PIP Chassis is connected to ground bus with 2" Braid

ISPR
Rack
Ground
Interface

ISPR Rack Ground Bus

**Mechanical Structure
Mounted to Ground Bus**

10-10-03

Appendix 37b

FDS Reporting Form
for the HRF MARES Rack

